

## Resources &amp; Environment



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## Organophosphate Insecticides Being Scrutinized, Restricted

The U.S. Environmental Protection Agency (EPA) is reviewing all pesticides that had residue tolerances (legally defined upper limits) for food in 1996, comparing assessment results with new safety standards, and taking regulatory actions when necessary to meet the standards. So far, preliminary results for 38 organophosphate (OP) pesticides have been announced, and numerous regulatory actions proposed or taken. A more comprehensive cumulative assessment is nearing completion, with preliminary results to be published December 1, 2001 and a revision by August 2002. This assessment may result in further regulatory actions.

OP pesticides were among the first reviewed, due to concerns about human health risks. OPs have been widely used in agriculture, making up over half the total acre-treatments of insecticides during the late 1990s to several major field crops and many fruits and vegetables. So far, most actions resulting from the review have affected OP use on fruit and vegetables, with such crops as apples and pears affected by more than one regulatory action.

The EPA review of pesticides, called for in the Food Quality Protection Act of 1996 (FQPA), is twofold. First, an aggregate assessment considers the risks from

dietary, drinking water (which contributes to dietary), and nonoccupational exposure across all uses of specific pesticide ingredients. Second, a cumulative assessment considers these same risks across all pesticides in a group, such as OPs, that have a common mechanism of toxicity. In addition under the ongoing reregistration process, EPA is simultaneously examining the same pesticides for ecosystem and worker safety risks.

Pesticides contribute to increased productivity in agriculture, but their use is associated with potential risks to human health, wildlife, and the environment. Of the 38 OPs reviewed so far, EPA has preliminarily identified more concerns with worker safety, ecosystem, and nonoccupational exposure risks than with dietary or drinking water risks.

Regulatory actions can include:

- cancellation of use registration, which would prohibit further use, and
- use restrictions, such as application rate reductions; limitations on where, when, or how pesticides can be used; worker protection requirements; and production caps that limit the quantity of the pesticide that can be produced or sold.

Some actions can severely restrict the use of pesticides and cause increases in pest control costs or yield losses, while others have little effect. Although EPA makes all regulatory decisions, the registrants, in response to risk assessments, often propose voluntary mitigating actions to avoid the time and legal costs of administrative hearings and procedures.

### *Restrictions on OPs Are Increasing*

So far, regulatory actions on agricultural uses of OPs to meet new standards for individual materials have been limited primarily to fruit and vegetable crops. Use on many extensively treated crops continues, but some major actions have affected residential and other nonagricultural uses rather than agricultural uses. However, some cancellations of agricultural uses have been proposed, and the cumulative assessment could result in further cancellations or use restrictions. Actions on food crops have primarily affected fruit and vegetables, in some cases to reduce dietary risks to children. Many fruits and vegetables are more extensively treated with OPs than are large acreage crops, such as corn, soybeans, cotton, and wheat.

In 1999 EPA's aggregate assessment identified three widely used OPs—azinphos methyl, chlorpyrifos, and methyl parathion—as having dietary, drinking water, or nonoccupational exposure risks in excess of standards. In some cases, ecosystem or occupational (worker) safety risks were noted. With EPA approval, registrants of these three insecticides took voluntary actions to reduce the risks identified by the review. Another widely used OP, diazinon, was identified with nonoccupational exposure, occupational, and ecosystem risks; regulatory actions have been proposed.

#### *Azinphos methyl*

Actions taken on this insecticide include rate restrictions on pome fruits (apples, pears, crabapples, and quinces) to reduce dietary risk, cancellation of use on cotton east of the Mississippi River and on sugarcane nationally to reduce drinking water exposure and risks to aquatic organisms, and an overall cap on the amount produced. Prior to the actions, apples and pears ranked first and third among major

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fruit and vegetable crops in proportion of acres treated, with 81 and 72 percent, respectively, and ranked second and fourth in percentage of insecticide treatments, with 27 and 20 percent (all data are multiyear averages during 1994-99). However, the use restrictions (maximum annual application rates of 4.5 pounds active ingredient per acre) reduced the affected acreage and treatments of apples and pears. Before the action, about 8 percent of apple and pear acres were treated at rates that exceeded the restriction, accounting for 5 percent of insecticide treatments on each crop.

About 5 percent of cotton acres were treated with azinphos methyl but the cancellation affected only the 1 percent treated east of the Mississippi River. Actions on other extensively-treated fruit crops were not needed to meet the aggregate risk standard. However, the production cap on the insecticide could limit the amount available for use. Also, although not an FQPA issue, actions may be needed to reduce worker exposure to the insecticide, which may further restrict use on apples, pears, and other crops.

### *Chlorpyrifos*

To reduce dietary risk, use of chlorpyrifos on tomatoes was cancelled, use on apples restricted to prebloom applications, and residue tolerances reduced on grapes. Of these crops, chlorpyrifos was used most extensively on apples, with 70 percent of apple acres treated and 12 percent of total insecticide treatments. Since USDA surveys do not record application timing for fruit and vegetable crops, the proportion of acres and treatments affected by the prebloom restriction is unknown.

Chlorpyrifos was used on 4 percent of grape-bearing acreage and 16 percent of fresh-market tomatoes. Use on tomatoes was concentrated in the Southeast (represented by Florida, Georgia, North Carolina), with 30 percent of the acreage treated, accounting for 5 percent of treatments, but less than 1 percent treated elsewhere. USDA surveys reported no acreage of processing tomatoes treated. Use of the insecticide on many extensively treated fruit and vegetable crops was not affected by the actions, such as use on 46 percent of acres planted to cauliflower.

### Provisions of the Food Quality Protection Act of 1996

The Food Quality Protection Act (FQPA) amended the Federal Insecticide, Fungicide, and Rodenticide Act and the Federal Food Drug and Cosmetic Act. It defined a uniform safety standard for pesticide-related risks in raw and processed foods as “a reasonable certainty of no harm from aggregate exposure to the pesticide chemical residue.”

EPA must consider the aggregate risks from dietary, drinking water (which contributes to dietary), and nonoccupational exposure (such as homeowner use of a pesticide for lawn care) for all uses of a pesticide when establishing residue limits (tolerances) in foods. FQPA requires EPA to consider increased susceptibility of infants, children, or other sensitive subpopulations and directs the use of an additional margin of safety of up to tenfold in setting residue tolerances. EPA must also consider the cumulative effects from other substances with a “common mechanism of toxicity,” which occurs if two or more pesticides cause a common toxic effect to human health by the same, or essentially the same, sequence of major biochemical events.

The law required an assessment against the new standard to be completed by 2006 of all pesticide residue tolerances (legally defined upper limits) existing in 1996. If aggregate risk of a pesticide exceeds the standard, EPA will reduce or revoke residue tolerances or modify or cancel use registrations to meet the standard.

### Understanding Pesticide Use Estimates

The estimates of percent of acres treated, treatments per acre, and percent of total insecticide treatments are 1994-99 averages of USDA pesticide data for 60 crops. Almonds, walnuts, hazelnuts, pistachios, peanuts, and sunflowers were excluded because they were surveyed in only 1 year. Also excluded was use on livestock. “Acres treated” measures the area receiving a pesticide, while a “treatment” is a single application of one pesticide on one acre. Some acres treated receive multiple treatments. Total treatments are acres treated times the average number of treatments per acre.

Multiyear averages were computed to reduce the effects of variable crop and pest conditions. Field crops were averaged from 1994-99; vegetable crops for 1994, 1996, and 1998; and fruit crops for 1995, 1997, and 1999. Acres treated, treatments, and surveyed acres were averaged for each state in each surveyed year before summation of the reported estimates. A state surveyed for fruit or vegetable crop was excluded if surveyed in only one year. A state surveyed for a field crop was excluded if surveyed in only 1 or 2 years.

Chlorpyrifos was one of the two most widely used insecticides for treating nonagricultural and residential pests. Use was cancelled in buildings, homes, and gardens in order to reduce nonoccupational exposure risks, including those to children.

### *Methyl parathion*

To reduce dietary risk, use was cancelled on more than 20 fruits and vegetables. The most affected included peaches (44 percent of acres treated), plums, apples, processing snap beans, nectarines, pears,

and tart cherries (13 percent of acres treated). Use was also cancelled on succulent peas and beans, tomatoes, and some nonfood crops to reduce ecosystem and worker safety risks. Use on cotton, with 15 percent of acreage treated, was not affected. Other treated crops not affected were fresh sweet corn, onions, and processing sweet corn.

### *Diazinon*

The proposed diazinon use cancellations to reduce worker and ecosystem risks will affect over 20 crops. Among these crops

## Risk Concerns Identified During Organophosphate Assessment

EPA's review to date of 38 organophosphate pesticides identified the following with risks of concern:

- 29 with worker safety risks
- 25 with ecosystem risks
- 12 with nonoccupational exposure risks of which 7 involved risk to children (in italics): *acephate*, bensulide, *chlorpyrifos*, *diazinon*, ethoprop, *fenthion*, *malathion*, naled, *phosmet*, propetamphos, *tetrachlorvinphos*, and *trichlorfon*
- 11 with drinking water risks, of which 3 involved risk to children (in italics): *acephate*, azinphos methyl, chlorpyrifos, *diazinon*, coumaphos, dicrotophos, ethoprop, fenamiphos, *methamidophos*, methyl parathion, and terbufos
- 5 with dietary risks, all of which involved risk to children: *azinphos methyl*, *chlorpyrifos*, *fenthion*, *methamidophos*, *methyl parathion*. (the dietary risk from methamidophos also considers acephate, which degrades into methamidophos)
- 3 with aggregate risk (even though no individual dietary, drinking water, and nonoccupational risk trigger was exceeded): disulfoton, ethion, phorate.

the most extensively treated with the insecticide have been 24 percent of fresh market spinach; 15 percent of bell pepper; and 10 percent or less of strawberry, celery, processing tomato, processing spinach, fresh market cucumber, and processing cucumber acres. However, use of the insecticide continues on some fruit and vegetable crops, ranging from over half the acres in raspberries to lesser proportions of nectarines, apricots, head lettuce, other lettuce, prunes, plums, blackberries, peaches, sweet cherries, carrots, onions, fresh market cabbage, and blueberries. EPA cancelled the material's use in buildings, homes, and gardens and by residents to reduce nonoccupational exposure risks, including those to children.

Some crops were affected by two or three of the actions on major OP insecticides: apples (azinphos, chlorpyrifos, methyl parathion), pears (azinphos, methyl parathion), tomatoes (chlorpyrifos, methyl parathion, diazinon), and cotton (azinphos, diazinon). About 10 percent of apple acres and 3 percent of pear acres were in orchards using two or three materials subject to actions on some acreage. The acreage affected by multiple actions has declined over time. Adoption of new pesticides, such as mating disrupters for codling moth management, may reduce OP use. Growers treated about 12 percent of Washington apple and pear acres with the new pesticides in 1999.

Besides the above four widely used OPs, EPA issued interim decisions for many other OPs to reduce nonoccupational exposure, worker, and ecosystem risks. These actions would affect relatively small crop acreages.

### ***Cumulative Review May Bring More Restrictions***

While the results of the cumulative assessment have not been announced, additional risk reduction measures may be required to meet the standard for OPs. There could be major modifications in insect control practices for crops relying heavily on OPs. Use of OPs on fruits and vegetables that comprise a high proportion of infants' and children's diets, which have a stricter safety standard, could be an important concern.

Some fruits and vegetables rank high both in extent (percent of acres treated) and intensity (average number of treatments per planted acre) of OP use across all planted acres. Extent and intensity are indicators of the crop area and insecticide treatments potentially affected if all food crop uses of OPs were to be cancelled. However, less disruptive actions might meet the cumulative standard.

Of major fruits and vegetables, apples rank highest by both indicators: 95 per-

cent of acres treated and an average of five treatments per planted acre. OPs were applied to more than 50 percent of acres and averaged more than 1 treatment per planted acre for 22 other major fruit or vegetable crops. In comparison, OPs are used on smaller proportions of acres for the two largest markets for these materials: cotton, with 50 percent treated and 2.2 treatments per planted acre, and field corn, with 18 percent treated. Some fruit and vegetable crops are particularly reliant on OPs; these materials account for more than 50 percent of insecticide treatments for apples, tart cherries, blueberries, sweet cherries, broccoli, snap beans for processing, and lima beans for processing.

The actions on OPs affected a substantial portion of treatments on some intensively treated fruit and vegetable crops. The actions on azinphos methyl, chlorpyrifos, and methyl parathion affected between 15 and 50 percent of OP treatments on apples, nectarines, peaches, processing snap beans, plums, pears, and fresh tomatoes. In addition, the proposed diazinon action would affect 10 to 12 percent of OP treatments on bell peppers, plums, and strawberries.

The resulting risk reductions could influence further actions needed to meet the cumulative standard, and the crops and pesticides affected. EPA could cancel or restrict any remaining crop uses of OPs, including the previously restricted use of chlorpyrifos on apples and azinphos methyl on pome fruits, which would be more severe and affect larger proportions of acres and treatments than did the earlier restrictions.

The FQPA review process, and especially the cumulative review, is complicated when pesticides are alternatives to each other. The economic and risk effects of a regulation depend upon which alternatives farmers use and how those alternatives were previously regulated. Conceivably, a regulation could increase health or environmental risks if an alternative has higher risks than the regulated pesticide. For example, the purpose of the production cap on azinphos methyl was to prevent unacceptable risks if growers used it instead of other regulated materials, such as methyl parathion.

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## Extent of Organophosphate (OP) Use Varies Among Crops

Crop	Average surveyed crop acreage 1994-99 <i>1,000 acres</i>	Share of crop acreage treated <i>Percent</i>	OP use			OP treatments potentially affected by EPA actions on:	
			Average treatments per <i>treated</i> acre <i>Number</i>	Average treatments per <i>planted</i> acre <i>Number</i>	Share of total insecticide treatments <i>Percent</i>	Azinphos methyl, chlorpyrifos, and methyl parathion <i>Percent of acre-treatments</i>	Diazinon (proposed)
Apples	356	95	5.3	5.0	54	19-42	*
Cherries, tart	34	94	3.3	3.1	76	9	*
Pears	67	88	3.2	2.8	33	23	*
Blueberries	34	80	3.8	3.0	70	*	*
Cherries, sweet	45	79	3.3	2.6	60	1	*
Limes	2	79	2.5	2.0	26	*	*
Peaches	134	78	4.0	3.1	46	47	*
Cauliflower	47	78	3.2	2.5	48	<1	*
Nectarines	37	73	1.8	1.3	26	18	*
Broccoli	120	72	2.6	1.9	51	<1	*
Lettuce, head	193	72	2.5	1.8	24	<1	*
Plums	44	66	1.5	1.0	42	26	*
Celery	28	66	2.6	1.7	17	1	10
Raspberries	13	65	1.9	1.3	40	*	*
Cabbage, processing	6	59	2.3	1.4	32	*	*
Potatoes	1,096	59	1.9	1.1	46	*	1
Beans, snap, processing	155	58	2.0	1.2	83	30	*
Peppers, bell	61	57	3.4	1.9	17	*	12
Cabbage, fresh	69	56	3.1	1.7	20	*	*
Tomatoes, fresh	96	56	4.5	2.5	19	21	4
Strawberries	45	55	3.0	1.6	25	*	12
Lettuce, other	75	54	1.9	1.0	17	1	*
Beans, lima, processing	30	53	1.8	1.0	77	--	*
Cotton	13,163	50	4.3	2.2	51	1	1
Lemons	49	49	1.2	0.6	25	*	<1
Tomatoes, processing	309	46	1.4	0.6	35	--	17
Grapefruit	141	37	1.5	0.6	16	*	1
Beans, snap, fresh	70	32	2.8	0.9	19	3	*
Oranges	806	31	1.6	0.5	16	*	<1
Tangelos	12	31	1.3	0.4	10	*	--
Spinach, fresh	14	31	1.8	0.6	17	2	67
Tangerines	35	27	1.5	0.4	11	*	1
Peas, processing	247	26	1.3	0.3	56	15	*
Temple	7	23	1.2	0.3	8	*	--
Corn	68,950	18	1.1	0.2	54	*	*
Carrots	114	15	1.7	0.2	27	5	*
Grapes	883	14	1.4	0.2	7	35	*
Cucumbers, fresh	51	13	2.1	0.3	7	*	26
Beans, lima, fresh	5	13	3.1	0.4	35	--	*
Spinach, processing	7	10	1.2	0.1	4	*	78
Cucumbers, processing	73	8	1.1	0.1	9	*	32
Winter wheat	34,874	7	1.1	0.1	96	*	*
Soybeans	62,883	1	1.2	<0.1	42	*	*

-- = No survey observations. \* = Not affected by action.

Source: USDA Chemical Use and Cropping Practices Surveys: Fruit crops 1995, 1997, 1999; vegetable crops 1994, 1996, 1998; field crops 1994-99.

Economic Research Service, USDA

The FQPA review works toward an overall reduction in risk since pesticides with the greatest risks to public health are reviewed first. Society may gain if relatively high risks are mitigated earlier in the process.

Most actions resulting from the OP assessment so far have affected fruits and vegetables; the effects of the cumulative

assessment remain to be seen. Ultimately, the economic effects will depend on the actions taken on specific pesticides and crops, how restrictive they are, the potential for pest damage, and the availability and cost effectiveness of alternatives. While EPA may have options to reduce the disruption of pest management practices and economic effects, the process

could have the greatest implications for fruit and vegetable crops. **AO**

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**For more information:**

ERS's web site: [www.ers.usda.gov/Briefing/AgChemicals](http://www.ers.usda.gov/Briefing/AgChemicals)

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